The foregoing description of the first embodiment of the present invention described detecting both of the multiple light beams for controlling the timing of scanning. It is to be understood, however, that the timing of scanning can also be controlled by detecting a part of at least one of the multiple light beams.

IN THE CLAIMS:

Please amend the claims and add new Claims 56 to 59 as follows. All claims currently pending in the application, including those not amended, are reproduced below. A marked-up copy of amended claims, showing the changes made thereto, is attached.

1. (Twice Amended) A multibeam scanning optical apparatus comprising:

a light source having a plurality of light beam emitting sections;

a light deflector for deflecting a plurality of light beams emitted respectively from the plurality of light beam emitting sections of said light source;

a scanning optical system for focusing the plurality of light beams deflected by said light deflector on a surface to be scanned; and

a photodetector for controlling a timing of a start of scanning of the plurality of light beams by detecting at least one of the plurality of light beams deflected by said light deflector as at least one detection light beam,

wherein the timing of the start of scanning is controlled to align the centers of scanning areas of the plurality of light beams with each other on the surface to be

scanned while allowing starting points of scanning of the plurality of light beams to differ from each other when the plurality of light beams have respective wavelengths that are different from each other.

2. (Twice Amended) A multibeam scanning optical apparatus according to claim 1, further comprising:

a detection optical element for converging the at least one detection light beam and leading the at least one detection light beam to said photodetector,

wherein said detection optical element has its optical surfaces arranged orthogonally relative to the at least one detection light beam.

3. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 2, wherein said detection optical element comprises an anamorphic lens.

4. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 2, wherein said detection optical element is made of a plastic material.

5. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 2, wherein said scanning optical system comprises a refraction optical element and a diffraction optical element.

6. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 5, wherein said refraction optical element and said diffraction optical element are made of a plastic material.

7. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 6, wherein said detection optical element and said refraction optical element are integrally formed by using a plastic material.

8. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 2, further comprising an incident optical system for leading the plurality of light beams emitted from said light source to said optical deflector.

9. (Amended) A multibeam scanning optical apparatus according to claim 8, wherein said incident optical system comprises a first lens for collimating each of said plurality of light beams emitted from said light source and a second lens for focusing each of said plurality of collimated light beams on the deflection plane of the optical deflector as a linear image extending in the main-scanning direction.

10. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 9, wherein said detection optical element and said second lens are integrally formed by using a plastic material.

11. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 1, wherein said photodetector detects part of each of the plurality of light beams deflected by said light deflector and controls the timing of the start of scanning of each of the plurality of light beams.

12. (Unchanged From Prior Version) A multibeam scanning optical apparatus comprising:

a light source having a plurality of light emitting sections;

a light deflector for deflecting a plurality of light beams emitted respectively from said plurality of light emitting sections of said light source;

a scanning optical system for focusing the plurality of light beams deflected by said light deflector on a surface to be scanned;

a first detection optical element for converging at least one of the plurality of light beams deflected by said light deflector as at least one detection light beam;

a second detection optical element for focusing the at least one detection light beam converged by said first detection optical element; and

a photodetector for controlling a time of a start of scanning of the plurality of light beams by detecting the at least one detection light beam focused by said second detection optical element,

wherein said first detection optical element has its optical surfaces arranged orthogonally relative to an arrangement direction of the at least one detection light beam.

13. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 12, wherein said first detection optical element comprises an anamorphic lens.

14. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 12, wherein said first detection optical element is made of a plastic material.

15. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 12, wherein said scanning optical system comprises a refraction optical element and a diffraction optical element.

16. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 15, wherein said refraction optical element and said diffraction optical element are made of a plastic material.

17. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 16, wherein said first detection optical element and said refraction optical element are integrally formed by using a plastic material.

18. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 12, further comprising an incident optical system for leading the plurality of light beams emitted from said light source to said light deflector.

40. (Unchanged From Prior Version) An image forming apparatus comprising:

a multibeam scanning optical apparatus as defined in any one of claims 1 to 18 and 42 to 55; and

an image carrier arranged on the surface to be scanned.

41. (Unchanged From Prior Version) A color image forming apparatus comprising:

a multibeam scanning optical apparatus as defined in any one of claims 1 to 18 and 42 to 55; and

a plurality of image carriers arranged respectively on the surface to be scanned for forming different images.

42. (Unchanged From Prior Version) A multibeam scanning optical apparatus comprising:

a light source having a plurality of light emitting sections;

a light deflector for deflecting a plurality of light beams emitted respectively from the plurality of light emitting sections of said light source;

a scanning optical system for focusing the plurality of light beams deflected by said light deflector on a surface to be scanned;

a photodetector for controlling a timing of a start of scanning of the plurality of light beams by detecting at least one of the plurality of light beams deflected by said light deflector as at least one detection light beam; and

a detection optical element for converging the at least one detection light beam and leading it to said photodetector, said detection optical element having a refractive power in the main-scanning direction,

wherein said detection optical element has its optical surfaces arranged orthogonally relative to an arrangement direction of the at least one detection light beam.

43. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 42, wherein said detection optical element comprises an anamorphic lens.

44. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 42, wherein said detection optical element is made of a plastic material.

45. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 42, wherein said scanning optical system comprises a refraction optical element and a diffraction optical element.

46. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 45, wherein said refraction optical element and said diffraction optical element are made of a plastic material.

47. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 46, wherein said detection optical element and said refraction optical element are integrally formed by using a plastic material.

48. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 42, further comprising an incident optical system for leading the plurality of light beams emitted from said light source to said light deflector.

49. (Unchanged From Prior Version) A multibeam scanning optical apparatus comprising:

a light source having a plurality of light emitting sections;

a light deflector for deflecting a plurality of light beams emitted respectively from the plurality of light emitting sections of said light source;

a scanning optical system for focusing the plurality of light beams deflected by said light deflector on a surface to be scanned;

a photodetector for controlling a timing of a start of scanning of the plurality of light beams by detecting at least one of the plurality of light beams deflected by said light deflector as at least one detection light beam; and

a detection optical element for converging the at least one detection light beam and leading it to said photodetector,

wherein said photodetector and the center of a scanning width in the main scanning direction on the surface to be scanned are held optically equivalent.

50. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 49, wherein said detection optical element comprises an anamorphic lens.

51. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 49, wherein said detection optical element is made of a plastic material.

52. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 49, wherein said scanning optical system comprises a refraction optical element and a diffraction optical element.

53. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 52, wherein said refraction optical element and said diffraction optical element are made of a plastic material.

54. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 53, wherein said detection optical element and said refraction optical element are integrally formed by using a plastic material.

55. (Unchanged From Prior Version) A multibeam scanning optical apparatus according to claim 49, further comprising an incident optical system for leading the plurality of light beams emitted from said light source to said light deflector.

56. (New) A multibeam scanning optical apparatus according to claim 1, wherein said photodetector controls a time of a start of scanning of the plurality of light beam by detecting all of the plurality of light beams deflected by said light deflector as detection light beams.

57. (New) A multibeam scanning optical apparatus according to claim 12, wherein said photodetector controls a time of a start of scanning of the plurality of light beam by detecting all of the plurality of light beams deflected by said light deflector as detection light beams.

58. (New) A multibeam scanning optical apparatus according to claim 42, wherein said photodetector controls a time of a start of scanning of the plurality of light beam by detecting all of the plurality of light beams deflected by said light deflector as detection light beams.

59. (New) A multibeam scanning optical apparatus according to claim 49, wherein said photodetector controls a time of a start of scanning of the plurality of light beam by detecting all of the plurality of light beams deflected by said light deflector as detection light beams.

60. (New) A multibeam scanning optical apparatus according to claim 12, wherein the plurality of light beams have respective wavelengths that are different from each other.

61. (New) A multibeam scanning optical apparatus according to claim 42, wherein the plurality of light beams have respective wavelengths that are different from each other.

62. (New) A multibeam scanning optical apparatus according to claim 49, wherein the plurality of light beams have respective wavelengths that are different from each other.

REMARKS

This application has been carefully reviewed in light of the Office Action dated September 18, 2002 (Paper No. 11). Claims 1 to 18 and 40 to 62 are in the application, with Claims 56 to 62 having been added herein. Claims 1, 12, 42 and 49 are

the independent claims. Reconsideration and further examination are respectfully requested.

Initially, Applicant thanks the Examiner for the indication that Claims 1 to 11 have been allowed. Claims 1 and 2 have been amended to indicate that the timing of the start of scanning fo the light beams is controlled by detecting at least one of the light beams. In addition, Claims 1 and 9 have been amended to correct typographical errors. None of the changes to Claims 1, 2 and 9, however, are believed to affect the allowability of the claims.

Applicant has also amended the specification to include the description contained in the initially filed claims of controlling timing of the start of scanning by detecting part of a least one of the plurality of light beams.

Claims 12, 13, 18, 42, 43, 48, 40/(12, 13, 18, 42, 43, 48) and 41/(12, 13, 18, 42, 43, 48) were rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,963,356 (Kato) in view of U.S. Patent No. 4,878,066 (Shiraishi); Claims 14, 44, 40/(14, 44) and 41/(14, 44) were rejected under § 103(a) over Kato in view of Shiraishi and further in view of U.S. Patent No. 5,365,259 (Kanoto); Claims 15, 45, 40/(15, 45) and 41/(15,45) were rejected under § 103(a) over Kato in view of Shiraishi and further in view of U.S. Patent No. 6,124,962 (Kamikubo); Claims 16, 17, 46, 47, 40/(16, 17, 46, 47) and 41/(16, 17, 46, 47) were rejected under § 103(a) over Kato in view of Shiraishi and Kamikubo and further in view of Kanoto; Claims 49, 50, 55, 40/(49, 50, 55) and 41/(49, 50, 55) were rejected under § 103(a) over Kato in view of U.S. Patent No. 5,834,766 (Suhara); Claims 51, 40/51 and 41/51 have been rejected under § 103(a) over Kato in view of Suhara and further in view of

Kanoto; Claims 52, 40/52 and 41/52 have been rejected under § 103(a) over Kato in view of Suhara and further in view of Kamikubo; and Claims 53, 54, 40/(53, 54) and 41/(53, 54) have been rejected under § 103(a) over Kato in view of Suhara and Kamikubo and further in view of Kanoto. Applicant has carefully considered the Examiner's comments together with the applied references and respectfully traverses the rejections for at least the following reasons.

The present invention concerns a multibeam scanning optical apparatus in which the optical surfaces of a detection optical element for focusing a detection light beam are arranged orthogonally relative to the direction of the detection light beam. With this arrangement, a photodetector that detects the focused detection light beam is held optically equivalent to a center of a scanning width in a main-scanning direction on a surface to be scanned by the multibeam scanning optical apparatus. In this manner, the centers of scanning areas of light beams on the surface to be scanned can be aligned to reduce jittering caused by differences in wavelengths of the light beams or environmental changes.

With reference to particular claim language, independent Claim 12 concerns a multibeam scanning optical apparatus that includes a light source having a plurality of light emitting sections and a light deflector for deflecting a plurality of light beams emitted respectively from the plurality of light emitting sections of the light source. A scanning optical system focuses the plurality of light beams deflected by the light deflector on a surface to be scanned. A first detection optical element converges at least one of the plurality of light beams deflected by the light deflector as at least one detection light beam.

A second detection optical element focuses the at least one detection light beam converged by the first detection optical element and a photodetector controls a timing of a start of scanning of the plurality of light beams by detecting the at least one detection light beam focused by the second detection optical element. The first detection optical element has its optical surfaces arranged orthogonally relative to an arrangement direction of the at least one detection light beam.

Independent Claim 42 concerns a multibeam scanning optical apparatus that includes a light source having a plurality of light emitting sections and a light deflector for deflecting a plurality of light beams emitted respectively from the plurality of light emitting sections of the light source. A scanning optical system focuses the plurality of light beams deflected by the light deflector on a surface to be scanned. A photodetector controls a timing of a start of scanning of the plurality of light beams by detecting at least one of the plurality of light beams deflected by the light deflector as at least one detection light beam. A detection optical element converges the at least one detection light beam and leads it to the photodetector, where the detection optical element has a refractive power in the main-scanning direction. The detection optical element has its optical surfaces arranged orthogonally relative to an arrangement direction of the at least one detection light beam.

The applied references are not understood to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not understood to disclose or suggest at least the feature of a multibeam scanning optical apparatus in which the optical surfaces of a detection optical element for focusing/converging at least one detection light beam are arranged orthogonally relative to

an arrangement direction of the at least one detection light beam.

The Office Action contends that the foregoing features of the invention are suggested by the combination of Kato and Shiraishi. Applicant respectfully submits that it is improper to combine Kato with Shiraishi in a § 103 rejection since the field of art of Kato is non-analogous to that of Shiraishi and there is no motivation for one skilled in the art to combine these references. Specifically, Shiraishi concerns a multibeam scanning apparatus while Kato concerns a single-beam scanning apparatus. Applicant respectfully asserts that one skilled in the art attempting to remedy a problem associated with a multibeam scanning apparatus would have no motivation to examine the field of art dealing with a single-beam scanning apparatus. For example, the present invention concerns jittering that is produced due to differences in wavelengths of the laser beams in a multibeam scanning apparatus and environmental changes. Since jittering is not a problem in a single-beam scanning apparatus, such as that disclosed in Kato, one skilled in the art looking to address a problem involving jittering in the multibeam scanning apparatus of Shiraishi would have no motivation to look to Kato for a solution. Accordingly, Applicant respectfully requests that the § 103 rejection over the combination of Kato and Shiraishi be withdrawn.

Shiraishi alone is also not understood to disclose the feature of a multibeam scanning optical apparatus in which the optical surfaces of a detection optical element for focusing/converging at least one detection light beam are arranged orthogonally relative to an arrangement direction of the at least one detection light beam. In the Office Action dated March 21, 2002 (Paper No. 9), it was contended that the lens 122 depicted in Figure

24 of Shiraishi disclosed a detection optical element disposed orthogonally to an optical path of detection light beams. Applicant respectfully disagrees with this interpretation of Shiraishi. Figure 24 of Shiraishi is merely a schematic diagram depicting an arrangement of the apparatus in Shiraishi. Nothing with respect to Figure 24 is understood to disclose that the lens 122 is positioned orthogonally to an optical path of detection light beams. Furthermore, Shiraishi is not understood to recognize the problem of jittering associated with a mulitbeam scanning apparatus and therefore is not understood to have a reason for arranging the lens 122 orthogonally to an optical path of detection light beams.

Kanoto, Kamikubo and Suhara, either alone or in combination, are not understood to disclose or suggest at least the feature of a multibeam scanning optical apparatus in which the optical surfaces of a detection optical element for focusing/converging at least one detection light beam are arranged orthogonally relative to an arrangement direction of the at least one detection light beam. Therefore, no proper combination of the applied references is understood to disclose or suggest at least the feature of a multibeam scanning optical apparatus in which the optical surfaces of a detection optical element for focusing/converging at least one detection light beam are arranged orthogonally relative to an arrangement direction of the at least one detection light beam.

Accordingly, independent Claims 12 and 42 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 103(a) rejection of Claims 12 and 42 are respectfully requested.

Independent Claim 49 concerns a multibeam scanning optical apparatus that

includes a light source having a plurality of light emitting sections and a light deflector for deflecting a plurality of light beams emitted respectively from the plurality of light emitting sections of the light source. A scanning optical system focuses the plurality of light beams deflected by the light deflector on a surface to be scanned. A photodetector controls a timing of a start of scanning of the plurality of light beams by detecting at least one of the plurality of light beams deflected by the light deflector as at least one detection light beam. A detection optical element converges the at least one detection light beam and leads it to the photodetector. The photodetector and the center of a scanning width in the main scanning direction on the surface to be scanned are held optically equivalent.

The applied references are not understood to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not understood to disclose or suggest at least the feature a photodetector and a center of a scanning width in a main-scanning direction being held optically equivalent.

Initially, Applicant notes that like Shiraishi, Suhara concerns a multibeam scanning apparatus. As discussed above with respect to Claims 12 and 42, Applicant submits that it is improper to combine Kato with a reference concerning a multibeam scanning apparatus to address jittering problems associated with a multibeam scanning apparatus. Therefore, Applicant respectfully requests that the § 103 rejection over the combination of Kato and Suhara be withdrawn.

Suhara concerns a multibeam scanning apparatus in which beam detection is performed using a photosensitive element. The Office Action contends that the surface to be scanned in Suhara is optically equivalent to the photosensitive element, where optical

equivalence is defined as the distance formed by a straight line from a facet of a deflecting element. Applicant respectfully submits that this definition of optical equivalence is different from that used in the present invention. As explained in the specification of the subject application beginning at page 12, line 4, the photodetector is held optically equivalent to a center of a scanning width in the main-scanning direction of the surface to be scanned by arranging the detection optical element orthogonal relative to the detection light beam. Accordingly, the optical equivalence utilized in the present invention concerns the arrangement of a detection optical element and not merely the distance from a reflecting facet. Suhara is not understood to disclose or even suggest the photosensitive element and the surface to be scanned being held optically equivalent in the manner described in the specification of the subject application.

As discussed above with respect to Claims 12 and 42, none of the applied references are understood to disclose or suggest the feature of a multibeam scanning optical apparatus in which the optical surfaces of a detection optical element for focusing/converging at least one detection light beam are arranged orthogonally relative to an arrangement direction of the at least one detection light beam. Therefore, none of the other applied references are understood to disclose or suggest holding a photodetector and the center of a scanning width in a main-scanning direction of a surface to be scanned optically equivelent. Accordingly, none of the applied references are understood to remedy the foregoing deficiencies of Suhara.

Accordingly, independent Claim 49 is believed to be allowable over the applied references. Reconsideration and withdrawal of the § 103(a) rejection of Claim 49 are respectfully requested.

The other claims in the application are dependent from the independent claims discussed above and are believed to be allowable for at least the same reasons. Because each dependent claim is deemed to define an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

In view of the foregoing remarks, the entire application is believed to be in condition for allowance and such action is respectfully requested at the Examiner's earliest convenience.

Applicant's undersigned attorney may be reached in our Costa Mesa, California, office by telephone at (714) 540-8700. All correspondence should be directed to our address given below.

Respectfully submitted,

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